



Technical Support Document: Toxicology Clandestine Drug Labs/ Methamphetamine

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COLEMAN FUEL

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Introduction

The clandestine synthesis of methamphetamine (meth) and other illegal drugs is a growing public health and environmental concern. For every pound of meth synthesized there are six or more pounds of hazardous materials or chemicals produced. These are often left on the premises, dumped down local septic systems, or illegally dumped in backyards, open spaces, in ditches along roadways or down municipal sewer systems. In addition to concerns for peace officer safety and health, there is increasing concern about potential health impacts on the public and on unknowing inhabitants, including children and the elderly, who subsequently occupy dwellings where illegal drug labs have been located.

The Office of Environmental Health Hazard Assessment (OEHHA), in cooperation with the Department of Toxic Substances Control (DTSC), has been charged with assisting in identifying and characterizing chemicals used or produced in the illegal manufacturing of methamphetamine, which pose the greatest potential human health concerns. To address in part this growing environmental problem and the need for public health and safety professionals to make appropriate risk management decisions for the remediation of former methamphetamine laboratory sites, OEHHA has developed two types of chemical-specific information documents.

The first set, technical support documents (TSDs), are referenced, multi-page publications, which contain important health and safety data, exposure limits, and key information for recognizing chemicals used or produced during the manufacturing of methamphetamine. These documents will likely be most helpful to health and safety officers, industrial hygienists, or others interested in more detailed toxicological information. The second set, two-page fact sheets, contain much of the same information as the corresponding TSDs; however, the details are presented in a more succinct, graphical format. The fact sheets will be helpful to individuals, including the public, who want to be able to quickly recognize potential chemicals of concern found in illegal methamphetamine labs in order to avoid inadvertent exposures and resulting health impacts.

For more information or to obtain copies of these and other documents, contact:

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www.dtsc.ca.gov/SiteCleanup/

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I. Chemical Name

A. COLEMAN FUEL

Specifications: Coleman Fuel is a complex mixture of light hydrocarbons (primarily aliphatic) produced by distillation of petroleum. Carbon number range is C₅ to C₉. Coleman Fuel is fully hydrotreated to remove aromatics, and contains less than 0.001% benzene. The boiling point range is 100-350° F (Goldsmith, 2002). Coleman Fuel contains up to 25% n-hexane and up to 15% cyclohexane by weight (Calumet, 1998).

B. Synonyms

Petroleum ether, petroleum naphtha, light hydrotreated petroleum distillate, white gas, Amsol 10, Kensol 10, VM&P (varnish makers & painters) naphtha, petroleum benzin.

II. Role in Clandestine Drug Synthesis: Methamphetamine

Coleman Fuel is a petroleum-based non-polar solvent used to extract methamphetamine base (Turkington, 2000).

III. Chemical Description

A. Appearance

Clear, colorless liquid (Calumet, 1998).

B. Taste

No information available.

C. Odor

Coleman Fuel has an odor resembling that of rubber cement.

D. Odor Threshold

Unknown (Calumet, 1998).

E. Irritancy Threshold

Not available.

F. Odor Safety Class

Not available.

G. Vapor Density

The vapor density of Coleman Fuel is 3 (air = 1); therefore, it is heavier than air (Calumet, 1998).

H. Vapor Pressure

For petroleum distillates: approximately 40 mmHg at 68°F (NIOSH, 1997).

IV. Containers and Packaging

A. Commercial Products

Commercial products include Coleman Fuel, Calumet Lantern Fuel, Amsol 10, Kensol 10, white gas, VM&P naphtha.

B. Pharmaceutical Use

No pharmaceutical uses for Coleman Fuel were identified.

V. Chemical Hazards

A. Reactivity

Coleman Fuel is stable under normal conditions; avoid sources of ignition, heat, and sunlight. Fumes, smoke, carbon monoxide, and other toxic gases may be produced from incomplete combustion (Calumet, 1998; Mallinckrodt, 2001).

B. Flammability

Coleman Fuel can form flammable mixtures with air and flash at room temperature. The lower explosive limit (LEL) for n-hexane, a major constituent of Coleman Fuel, is 1.2% (by volume, room temperature); the upper explosive limit (UEL) is 7.5% (Lewis, 2002). Similar explosive ranges have been reported for petroleum distillates (naphtha) and Amsol 10, a commercial product with a composition similar to Coleman Fuel (NIOSH, 1997; Americhem, 2001).

Coleman Fuel is an explosion hazard (Calumet, 1998). Ignition sources must be kept away from fumes (Americhem, 2001). Coleman Fuel vapor is heavier than air, thus vapor may travel considerable distance to a source of ignition and flash back (Calumet, 1998).

C. Chemical Incompatibilities

Coleman Fuel is incompatible with strong oxidizers (Calumet, 1998).

VI. Health Hazards

A. General

Primary routes of uptake are inhalation and absorption across the skin. Coleman Fuel is irritating to the eyes, skin, and respiratory tract (Calumet, 1998). Short-term (one-time) exposure to high concentrations of Coleman Fuel vapor can cause light-headedness and depression of the central nervous system. Due to the presence of n-hexane in Coleman Fuel, long-term (weeks-months) exposure to this solvent can lead to peripheral neuropathy, i.e., damage to sensory and motor neurons (HSDB, 2002A). Concurrent exposure to alcohol, acetone, methyl ethyl ketone, methyl isobutyl ketone, lead acetate, or chloroform may increase the toxic effects of n-hexane (Americhem, 2001; HESIS, 2000).

B. Acute Effects

Acute exposure to Coleman Fuel may be irritating to the eyes and skin (Calumet, 1998). Upon contact, Coleman Fuel may dissolve fats, leading to eye and skin irritation and tissue damage. Coleman Fuel vapor is a mild central nervous system depressant and may cause dizziness, giddiness, slight nausea, headache, and eye and throat irritation following acute inhalation exposure (HSDB, 2002A).

C. Chronic Effects

Skin and eye irritation may result from prolonged and/or repeated contact with Coleman Fuel (Calumet, 1998). Prolonged exposure may also adversely affect the kidneys, liver, and respiratory system, or aggravate pre-existing conditions in these organs (Americhem, 2001). In industrial settings, chronic (months-years) inhalation of n-hexane, a major component of Coleman Fuel, may result in peripheral neuropathy, characterized by tingling, numbness, or burning in the feet, legs, and/or hands, as well as muscular weakness and impaired gait (HESIS, 2000; HSDB, 2002A). If exposure to n-hexane continues after the appearance of peripheral neuropathy, paralysis may ensue (HESIS, 2000). In addition, permanent brain damage may result from prolonged inhalation of hydrocarbon solvents (Americhem, 2001).

D. Skin Contact

Skin irritation usually follows short-term exposure, and chronic dermatitis often results from long-term exposure (Calumet, 1998). Defatting of skin, redness, chemical dermatitis, and toxic systemic effects from absorption across the skin are possible (Americhem, 2001).

E. Eye Contact

Most petroleum hydrocarbon solvents are acute irritants; moderate burning, tearing, redness, and swelling are typical symptoms (Calumet, 1998; Americhem, 2001).

F. Inhalation

Loss of appetite, muscle weakness, impairment of motor function, dizziness, throat irritation, and drowsiness are indicative of overexposure (Mallinckrodt, 2001). Inhalation of Coleman Fuel may also cause central nervous system depression, impaired coordination, headaches, loss of consciousness, severe respiratory tract irritation, and suffocation. (Americhem, 2001; HSDB, 2002B).

Inhalation of n-hexane may cause drowsiness, headache, fatigue, blurred vision, loss of appetite (anorexia), polyneuropathy, and paresthesia, i.e. burning or prickling sensation in the extremities (e.g., finger tips and toes) (Lewis, 2002).

G. Ingestion

In general, ingestion of petroleum-based solvents can cause headache, nausea, vomiting, diarrhea, blurred vision, drowsiness, fatigue, pneumonitis, vertigo, pulmonary edema, central nervous system depression, convulsions, and loss of consciousness (Calumet, 1998; Mallinckrodt, 2001; HSDB, 2002A). Ingestion is also likely to cause a burning sensation in the mouth, esophagus, and stomach along with gastrointestinal irritation (Mallinckrodt, 2001; Americhem, 2001).

Ingestion of Coleman Fuel is an *aspiration hazard*, i.e., ingested Coleman Fuel can be inadvertently inhaled into the lungs, resulting in inflammation and possible life-threatening fluid accumulation in the lungs (pulmonary edema) (Phillips, 2001). Chemical pneumonitis, which can be fatal, can result from aspiration of ingested Coleman Fuel into the lungs. For this reason, vomiting should not be induced following ingestion. The danger from aspiration into the lungs is likely to exceed short-term systemic toxicity (Americhem, 2001).

H. Predisposing Conditions

Individuals with pre-existing skin disorders, eye problems, or impaired liver, kidney, or respiratory function may be more susceptible to the adverse health effects of Coleman Fuel (Mallinckrodt, 2001).

I. Special Concerns for Children

Compared to adults, children have a greater ratio of lung surface area to body weight. Similarly, the ratio of respiratory minute volume to body weight is greater in children than adults. Therefore, at any given concentration of Coleman Fuel in air, children will probably receive a larger dose than adults. In addition, the vapor density of Coleman Fuel is greater than that of air. Therefore, higher concentrations of Coleman Fuel are likely to be found closer to the ground. Children may be exposed to higher concentrations of Coleman Fuel than adults because of their short stature. Children may be more sensitive to inhaled Coleman Fuel because of the smaller diameter of their airways. Therefore, if the inhaled dose is sufficient to cause swelling or spasms of the larynx, upper airway obstruction and asphyxia are more likely to occur in children. Children may be more susceptible to the toxic effects of Coleman Fuel because they are often less likely to leave an area where a release has occurred.

VII. First Aid

A. Eyes

Flush eyes immediately with water for a minimum of fifteen minutes, occasionally lifting lower and upper lids. Get medical attention promptly (Calumet, 1998).

B. Skin

Exposed skin should be washed thoroughly with soap and water. Contaminated clothing should be removed immediately and laundered before reuse. Obtain medical assistance if irritation or rash appears (Calumet, 1998).

C. Ingestion

Do not induce vomiting; potential adverse health effects resulting from aspirating Coleman Fuel into the lungs usually exceeds short-term toxic effects resulting from systemic absorption. Obtain medical assistance immediately (Calumet, 1998; Americhem, 2001). If vomiting does occur, keep head below hips to prevent aspiration into lungs (Mallinckrodt, 2001).

D. Inhalation

The individual should be removed to fresh air and medical assistance obtained. Give oxygen if breathing is difficult; if individual is not breathing, give artificial respiration (Calumet, 1998).

VIII. Standards for Inhalation Exposure

A. Occupational Exposure Limits (NIOSH, 1997) for petroleum distillates

1. Ceiling Limit (C) (not to be exceeded at any time): 444 ppm (1800 mg/m³) [15-minute]
2. Short-Term Exposure Limit (STEL or ST): Not established.
3. 8-Hour Time Weighted Average (TWA): 500 ppm (2000 mg/m³)
4. 10-Hour Time Weighted Average (TWA): 86 ppm (350 mg/m³)
5. Immediately Dangerous to Life & Health (IDLH): 1100 ppm (4455 mg/m³)

NOTE: The 10-hour Time-Weighted-Average for n-hexane, which comprises up to 25% of Coleman Fuel, is 50ppm (180 mg/m³). The 8-hour Time-Weighted-Average for n-hexane is 500 ppm (1800 mg/m³).

Important Definitions Follow:

Ceiling Limit (C) is a concentration that must not be exceeded during any part of the workday.

Short-Term Exposure Limit (STEL or ST) is a 15-minute time-weighted average concentration that should not be exceeded during any part of the workday.

8-Hour Time Weighted Average (8-hour TWA) concentration is an exposure standard that must not be exceeded during any 8-hour work shift of a 40-hour workweek. 8-Hour TWA exposure standards established by the Occupational Safety and Health Administration (OSHA) are called Permissible Exposure Limits (PELs). 8-Hour TWA exposure standards established by the American Conference of Governmental Industrial Hygienists (ACGIH) are called Threshold Limit Values (TLVs).

10-Hour Time Weighted Average (10-hour TWA) concentration is an exposure standard that must not be exceeded during a 10-hour workday of a 40-hour workweek. 10-Hour TWA exposure standards developed by the National Institute for Occupational Safety and Health (NIOSH) are called Recommended Exposure Limits (RELs).

Immediately Dangerous to Life & Health (IDLH) defines a concentration which poses a threat of death or immediate or delayed permanent health effects, or is likely to prevent escape from such an environment in the event of failure of respiratory protection equipment. IDLH values are developed by the National Institute for Occupational Safety and Health (NIOSH).

“Skin” notation (NIOSH): significant uptake may occur as a result of skin contact. Therefore, appropriate personal protective clothing should be worn to prevent dermal exposure.

B. Emergency Response Planning Guidelines (1 hour or less) (AIHA, 2002)

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|--|------------------|
| 1. ERPG-1 (protective against mild, transient effects): | Not established. |
| 2. ERPG-2 (protective against serious adverse effects): | Not established. |
| 3. ERPG-3 (protective against life-threatening effects): | Not established. |

Emergency Response Planning Guidelines (ERPGs) are developed by the American Industrial Hygiene Association (AIHA) to assist in planning and preparation for catastrophic accidental chemical releases. ERPGs allow emergency response planners to estimate the consequences of large-scale chemical releases on human health, and evaluate the effectiveness of prevention strategies and response capabilities. ERPGs assume that the duration of exposure is one hour or less. They are not intended to be used as limits for routine operations and are not legally enforceable.

Definitions for the three ERPG levels are:

ERPG-1: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.

ERPG-2: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

ERPG-3: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

C. Acute Reference Exposure Level (1-hour exposure) (OEHHA, 1999)

Level protective against mild adverse effects: Not established.

D. Chronic Reference Exposure Level (multiple years) (OEHHA, 2002)

Level protective of adverse health effects: Not established.

Reference Exposure Levels (RELs) are developed by the California EPA's Office of Environmental Health Hazard Assessment (OEHHA). A REL is a concentration at or below which no adverse health effects are anticipated, even in the most sensitive members of the general population (for example, persons with pre-existing respiratory disease). RELs incorporate uncertainty factors to account for information gaps and uncertainties in the toxicological data. Therefore, exceeding a REL does not necessarily indicate an adverse health impact will occur in an exposed population. Acute RELs are based on an assumption that the duration of exposure is one hour or less. Chronic RELs are intended to be protective for individuals exposed continuously over at least a significant fraction of a lifetime (defined as 12 years).

E. Chronic Reference Concentration (lifetime exposure) (IRIS, 2003)

Level protective of adverse health effects: Not established.

IX. Environmental Contamination Concerns

No ecological data are available specifically for Coleman Fuel (Calumet, 1998). The following sub-sections are based on petroleum ether.

A. Surface Water

When released to water, petroleum ether is expected to biodegrade and evaporate. The bioconcentration factor (BCF) for petroleum ether is estimated to be less than 100 (Mallinckrodt, 2001). Therefore, bioconcentration of petroleum ether in aquatic organisms is not likely to be a major environmental concern (HSDB, 2002B). A small amount of Coleman Fuel may dissolve into water; in cases where the volume of dilution is very large (e.g., a spill into a river), the majority of the spilled solvent may dissolve before it evaporates.

B. Groundwater

Potential for groundwater contamination is low due to biodegradation and lack of water solubility (Mallinckrodt, 2001). Compounds having a lower molecular weight (five or six carbon atoms) will migrate more quickly through soil than heavier compounds, and thus have greater potential to contaminate groundwater.

C. Drinking Water

No information available.

Suggested No Adverse Response Level (NAS, 1980): Not established.

Preliminary Remediation Goal for Tap Water (U.S. EPA, 2002 Region IX): Not established.

D. Soil

Petroleum ether is expected to readily biodegrade and evaporate from both moist and dry soils (Mallinckrodt, 2001). Coleman Fuel and petroleum ether are both complex hydrocarbon mixtures, and adsorption to sediment and mobility within soil will vary based on estimated K_{oc} values of 81 to 650 (HSDB, 2002B). Compounds having a lower molecular weight (five or six carbon atoms) will migrate more quickly through soil than heavier compounds, and thus have greater potential to contaminate groundwater.

Preliminary Remediation Goal for Residential Soil (U.S. EPA, 2002 Region IX): Not established.

E. Air

In the atmosphere petroleum ether will predominantly exist in the vapor phase and will be degraded by reaction with sunlight. Removal of petroleum ether from the atmosphere also may occur through wet deposition (HSDB, 2002B).

Preliminary Remediation Goal for Ambient Air (U.S. EPA, 2002 Region IX): Not established.

F. Indoor Surface Contamination

Contamination of indoor surfaces should not be a concern, as Coleman Fuel will readily evaporate.

X. Personal Protective Equipment

Safety glasses/splash goggles or a face shield should be worn, and a suitable eye water wash should be available. Prolonged and/or repeated skin contact should be avoided; however, if prolonged contact cannot be avoided, wear impervious gloves and clothing made of neoprene, nitrile, or viton (Calumet, 1998). When air concentrations exceed permissible exposure limits, NIOSH/MSHA approved respirators should be worn (Americhem, 2001). Oil resistant clothing should be worn if splashing is likely to occur. Solvent-soaked clothing should be removed, allowed to dry completely, and then laundered or dry cleaned before wearing. Solvent-soaked shoes should be discarded. Maintain ventilation to keep air concentration at a minimum and remain upwind (Calumet, 1998).

XI. References

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¹ Americhem citations refer to a product with 10.5% n-hexane, while actual Coleman Fuel has up to 25% n-hexane. n-Hexane is responsible for the long-term neurotoxic symptoms described in this report.

² All HSDB-H citations are for n-hexane.

³ All HSDB citations are for petroleum ether.

⁴ All HCDR citations are for n-hexane.

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⁵ All Mallinckrodt citations are for petroleum ether.

⁶ Phillips citations refer to a compound with greater than 60% n-hexane, while actual Coleman Fuel has only up to 25%. n-Hexane is responsible for the long-term neurotoxic symptoms described in this report.